

Real Options & Cost Models

James Alleman

University of Colorado & PHB Hagler Bailly, Inc.

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Agenda

- Investment Theory
- Real Options Approach
- Uncertainties
- Overview of Cost Models
- Cost Models Applications
- Conclusions

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Overview

"The new view of investment opportunities as options has shown that the traditional "net present value" rule can give very wrong answers."

Dixit & Pindyck
Investment under Uncertainty, page ix

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Agenda

- Investment Theory
 - ▶ Olde Tyme View
 - ▶ Decision Tree Analysis

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Investment Theory: Olde Tyme View

- Investment Valuation:
 - ▶ Net Discounted Present Value
 - ▶ Jorgenson's User cost of capital
 - ▶ Tobin's q:

Dixit & Pindyck
Investment under Uncertainty, Chapters 1 & 2

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What is Real Options?

- Traditional DCF
 - ▶ Management's flexibility not captured
 - adaptable
 - revise decisions

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What is Real Options? (continued)

- **Traditional DCF**
 - ▶ Management's flexibility not captured
 - adapt
 - revise decisions
 - ▶ **DCF**
 - Static operating strategy
 - Cash flows are projected with certainty
 - Discount rate accounts for uncertainty

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What is Real Options? (continued)

- **Traditional DCF**
- **Real world**
 - ▶ Change
 - ▶ Uncertainty
 - ▶ Competitive interactions

What is Real Options? (continued)

- **Traditional DCF**
- **Real world**
- **New information**
 - ▶ Flexibility to alter strategy
 - ▶ Flexibility similar to financial options
 - ▶ Modelled with financial option tools

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Investment Theory: Olde Tyme View

- **Traditional**
- **Discounted Present Value**
 - ▶ $DPV > 0$, invest
 - ▶ Also called NDPV or DPV or PV
 - ▶ $DPV = \sum_{t=1}^T CF_t / (1+r)^t$

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Olde Tyme: Discounted Value

- **Discounted Present Value**
 $DPV = \sum CF_t / (1+r)^t$, summed over $t = 0, T$
- **Note the cash flow includes revenue!**

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Olde Tyme: Discounted Value

- **Discounted Present Value**
 $DPV = \sum CF_t / (1+r)^t$, summed over $t = 0, T$
 - ▶ Revenue in the cash flow!
- **Price is endogenous**

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- **Discounted Present Value**

$DPV = \sum CF_i / (1 + r)^t$, summed over $t = 0, T$

- ▶ Revenue in the cash flow
- ▶ Price is endogenous

- **No Depreciation**

Olde Tyme: Discounted Value

- **Discounted Present Value**

$DPV = \sum CF_i / (1 + r)^t$, summed over $t = 0, T$

- ▶ Revenue in the cash flow
- ▶ Price is endogenous

- **No Depreciation**

Except for tax consequences
Termination: Economic depreciation

Olde Tyme: Discounted Value

- **Discounted Present Value**

$DPV = \sum CF_i / (1 + r)^t$, summed over $t = 0, T$

- ▶ Revenue in the cash flow
- ▶ Price is endogenous
- ▶ No Depreciation

- **"r" Constant**

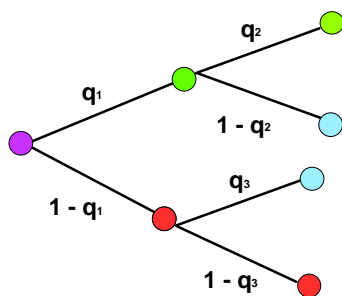
- ▶ Constant discount rate over time
- ▶ Opportunity cost of capital

Investment Theory: DTA

- **Investment Theory**

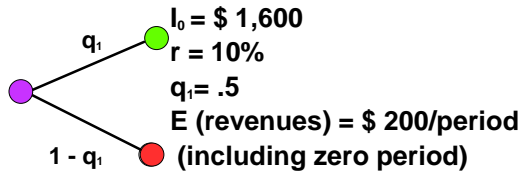
- ▶ Olde Tyme View
- ▶ Decision-tree Analysis (DTA)

Investment Theory: DTA



Investment Theory: DTA

- **Ex Post Decision**
- **Expected Value of DTA**
- **Risk-adjusted Rate**

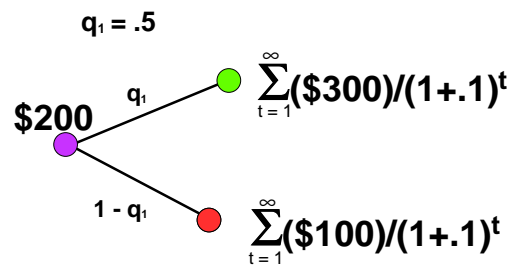


Dixit & Pindyck
Investment under Uncertainty, Chapter 2

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Investment Theory: DTA



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Investment Theory: DTA, example

DCF =

$$\sum_{t=0}^{\infty} (\$200)/(1+.1)^t - \$ 1,600 =$$

$$\$2,200 - \$1,600 =$$

$$\$600$$

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Investment Theory: DTA, example

Wait one period:

Expanded DCF =

$$(.5)[(\$300/.1) - \$ 1,600/1.1] =$$

$$(.5)[\$3,000 - \$1,455] =$$

$$\$ 773$$

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Investment Theory: DTA, example

Value of Options to Delay:

Expanded - static DCF =

$$\$ 773 - 600 =$$

$$\$ 173$$

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Opportunity Cost-of-capital

- Divine discount rate!?
- Options Pricing Model
 - ▶ Security of equivalent risk
 - ▶ Calculate implied rate

Real Options Approach

- Investment Theory
- Real Options Approach
 - ▶ Definition
 - ▶ Characteristics
 - ▶ Investment characteristics

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Real Options Approach

- Option definition
 - ▶ The "right" purchase an asset in the future but not the obligation
 - ▶ Value due to uncertainty of future

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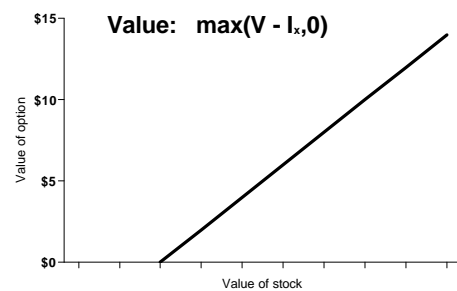
Real Options Approach

- Options characteristic
 - ▶ Time limited
 - ▶ "Killed" or exercised terminates

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Value of option



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Real Options Approach: Flexibility

- Defer
 - Expand
 - Abandon
 - Start up (Shut down)
-

Types of Real Options

- Natural
 - ▶ Option to defer a capital investment
 - ▶ Option to abandon
- Planned for and created
 - ▶ Research & development
 - New services/products
 - ▶ Alter investment levels
 - As state of nature revealed

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- **Investment Characteristics**

- ▶ Irreversibility
- ▶ Uncertainty
- ▶ Timing

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Investment under Uncertainty, Chapters 1 & 2

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Real Options Approach

- **Irreversibility**

Investments become sunk cost (irreversible) when:

- ▶ Firm or Industry specific
- ▶ Regulations/laws
- ▶ Partially irreversible, "lemons"

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Real Options Approach

- Irreversibility
- **Waiting**
 - ▶ Preempt investments preclude
 - ▶ Cost of delay
 - Competitive entry
 - Foregone revenues

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Real Options Approach

- **Opportunity cost of option**

- ▶ Include in valuation
- ▶ i.e. if the NDPV plus the option value > 0, invest

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Agenda

- Investment Theory
- Real Options Approach
- **Uncertainties**

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Uncertainties

- Regulation/Legislative
- Competition
- Technologies
- Costs
- Market

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Uncertainties

- **Regulation/Legislative**
 - ▶ Courts: Suspension of FCC Orders
 - ▶ Regulation: Decisions on RBOC LD
 - ▶ Legislative: Re-regulation of Cable
 - ▶ etc.

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Uncertainties

- **Regulation/Legislative**
- **Competition**
 - ▶ Traditional: ATT/MFS/TPG
 - ▶ Incumbent's reaction(s)
 - ▶ Cable's Strategies
 - Entry into exchange market
 - Broadband modems

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Uncertainties

- **Regulation/Legislative**
- **Competition**
- **Technologies**
 - ▶ **Wireless impact**
 - WinStar
 - Wireless local loop
 - ▶ **ISP/Packet Network versus circuit**

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Uncertainties

- **Regulation/Legislative**
- **Competition**
- **Technologies**
- **Costs**
 - ▶ **Spectrum costs**
 - ▶ **Unbundled Network Elements**
 - ▶ **Right of way**
 - ▶ **Leases**

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Uncertainties

- **Regulation/Legislative**
- ...
- **Costs**
- **Market**
 - ▶ **Product acceptance**
 - ▶ **Price and cross-elasticities**
 - ▶ **Size**
 - ▶ **Growth**

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Agenda

- **Investment Theory**
- **Real Options Approach**
- **Uncertainties**
- **Overview of Cost Models**
 - ▶ **Assumptions**
 - ▶ **Depreciation**
 - ▶ **Prices**

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Overview

Asset Valuation:
Price can only be determined
if all costs -- including the
depreciation-- are included

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Overview

"... depreciation and theoretical selling price must be computed simultaneously ..." to determine correct valuation.

Harold Hotelling, 1925.

Forward-looking Costs for Capital Inputs in a
Competitive/Regulated Environment
Michael A. Salinger
AEI Conference, November 4th 1997

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Costs Models

- "One-hoss shay"/Light bulb
- Assumptions
 - ▶ Constant price
 - ▶ Constant output
 - ▶ Constant expenses
 - ▶ Certainty of life

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Depreciation

- Accounting Depreciation
 - ▶ Arbitrary cost allocation (over time)
 - ▶ Industry/regulators determine
 - ▶ Not an economic cost
 - ▶ Not equal to economic depreciation

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Depreciation

- Accounting depreciation
 - ▶ Used for prices/rates
 - ▶ Regulatory Compact
 - Payments cover costs
 - Investment plus return

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Depreciation

- Accounting Depreciation
- Economic Depreciation
 - ▶ Determinates
 - Rental market
 - Secondhand markets
 - Profit generated
 - "Lemons" problem
 - Real options valuation

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Depreciation

- Accounting Depreciation
- Economic Depreciation
- Sunk/Irreversible Costs
 - ▶ No rental or secondhand markets
 - ▶ Telecommunications systems

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Prices

- **Competition:**
 - ▶ Constrains future prices.
- **Forward-looking cost:**
 - ▶ Limits future prices

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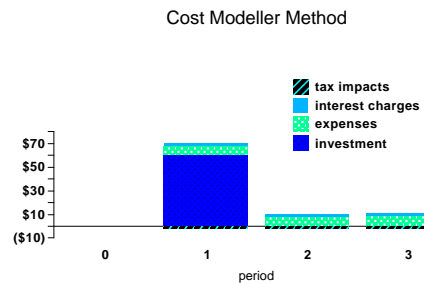
Agenda

- Investment Theory
- Real Options Approach
- Uncertainties
- Overview of Cost Models
- **Cost Models Applications**

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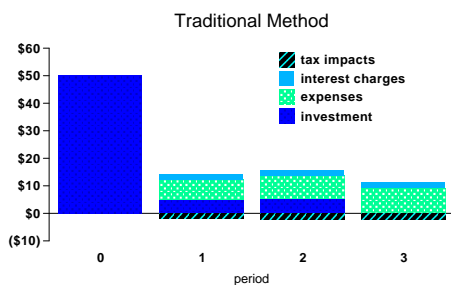
Cash Flow (negative)



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Cash Flow (negative)



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Cost Model Applications

Module

- ▶ Quantity

Problem

- ▶ No demand elasticity
- ▶ No market share decrement
- ▶ No growth
- ▶ Constant output

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering design & relationships

Problem

- ▶ ...
- ▶ No technological substitution
- ▶ No economies of scale/scope
- ▶ No factor price consideration

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering ...
- ▶ Expenses

Problem

- ▶ ...
- ▶ ...
- ▶ Annualized as proportion of investments
- ▶ No labor/capital substitution
- ▶ Constant expenses

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering ...
- ▶ Expenses
- ▶ Depreciation

Problem

- ▶ Not economic, but accounting
- ▶ Not tax schedule
- ▶ Schedule from Joint Board
- ▶ Certainty of life
- ▶ Non-economic calculation

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering ...
- ▶ Expenses
- ▶ Depreciation
- ▶ Rate-base, rate-of-return revenue

Problem

- ▶ No dynamics
- ▶ One price
- ▶ No change in input or output prices
- ▶ Static discount/interest rate

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering ...
- ▶ Expenses
- ▶ Depreciation
- ▶ ROR
- ▶ Investment determined

Problem

- ▶ one time investment
- ▶ static factor prices
- ▶ light bulb model
- ▶ no economies of scale/scope
- ▶ static discount rate
- ▶ constant capacity
- ▶ no differentiated risk
- ▶ no real options

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Cost Model Applications

Module

- ▶ Quantity
- ▶ Engineering ...
- ▶ Expenses
- ▶ Depreciation
- ▶ ROR
- ▶ Investment ...
- ▶ Revenue requirement/quantity determines price!

Problem

- ▶ No price effects
- ▶ Revenue requirement level
- ▶ No competitive impacts
- ▶ No market share loss

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Summary/Conclusions

- Present Value Inadequate
- Cost Models Inadequate
- Cost Models Adaptable

Summary/Conclusions

- Present Value Inadequate
 - ▶ No Dynamics
 - ▶ No Uncertainties
 - ▶ No Options Valuation

Summary

- Present Value Inadequate
- Cost Models Inadequate

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Summary

- Present Value Inadequate
- Cost Models
 - Inadequate Specifications:**
 - ▶ No change in cost of asset
 - ▶ No risk of underutilization
 - ▶ Revenue requirement level
 - ▶ Utilization rate level
 - ▶ No real option valuation

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Summary/Conclusions

- Present Value Inadequate
- Cost Models Inadequate
- Cost Models Adaptable
 - ▶ Real Options applicable
 - ▶ Competitive markets emulated

Forward-looking Costs & Option Valuation

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Telecommunications Economics
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